

# Claims

- [c1] A directional casing drilling system, comprising:
  - a casing string for rotation of a drill bit;
  - a shaft coupled to the casing string;
  - a sleeve having pads hydraulically extensible therefrom, the sleeve positioned about at least a portion of the shaft;
  - a tube connecting the sleeve to the drill collar, the tube adapted to conduct drilling fluid therethrough; and
  - a valve system adapted to operatively conduct at least a portion of the drilling fluid to the pads whereby the pads move between an extended position and a retracted position.
- [c2] The directional casing drilling system according to claim 1, wherein the pads are selectively extensible by application of drilling fluid thereto.
- [c3] The directional casing drilling system according to claim 1, further comprising at least one stabilizer blade located on the sleeve, each stabilizer blade having at least one pad therein.
- [c4] The directional casing drilling system according to claim

3, wherein each pad comprises a piston.

[c5] The directional casing drilling system according to claim 4, wherein the at least one stabilizer blade comprises at least one first conduit adapted to conduct fluid from the sleeve to at least one pad contained therein.

[c6] A method of drilling a wellbore, comprising:  
positioning a drilling tool connected to the end of a casing string in a wellbore, the drilling tool having a bit and a sleeve with extendable pads therein;  
passing a fluid through the tool; and  
diverting at least a portion of the fluid to the sleeve for selective extension of the pads whereby the tool drills in a desired direction.

[c7] A rotary steerable casing drilling system, comprising:  
a casing string for rotation of a drill bit;  
a tool collar comprising an interior, an upper end and a lower end, the upper end of the tool collar operatively coupled to the casing string;  
a bit shaft comprising an exterior surface, an upper end and a lower end, the bit shaft being supported within the tool collar for pivotal movement about a fixed position along the bit shaft;  
a variable bit shaft angulating mechanism, located within the interior of the tool collar, comprising a motor, an

offset mandrel having an upper end and a lower end, and a variable offset coupling, having an upper end and a lower end, the motor attached to the upper end of the offset mandrel and adapted to rotate the offset mandrel, the upper end of variable offset coupling being uncoupleably attached to an offset location of the lower end of the offset mandrel, and the upper end of the bit shaft being rotatably coupled to the variable offset coupling; a torque transmitting coupling adapted to transmit torque from the tool collar to the bit shaft at the fixed position along the bit shaft; and a seal system adapted to seal between the lower end of the collar and the bit shaft.

- [c8] The rotary steerable casing drilling system according to claim 7, further comprising a lock ring adapted to uncoupleably attach the variable offset coupling to the offset location of the offset mandrel.
- [c9] The rotary steerable casing drilling system according to claim 8, further comprising an actuator adapted to uncouple the offset mandrel from the variable offset coupling.
- [c10] The rotary steerable drilling casing system according to claim 9, wherein the lock ring comprises an outer ring on which the actuator acts.

[c11] The rotary steerable drilling casing system according to claim 10, wherein the actuator comprises a linear actuator.

[c12] The rotary steerable drilling casing system according to claim 11, wherein the linear actuator comprises a motor/ball screw assembly type.

[c13] The rotary steerable drilling casing system according to claim 12, wherein the bit shaft, at the fixed point, comprising a plurality of protrusions extending radially from the exterior surface of the bit shaft, wherein the torque transmitting coupling comprises:

a ring having an inner surface, a perimeter, and a plurality of perforations around the perimeter, wherein the ring surrounds the bit shaft and each protrusion is aligned with a perforation of the ring; and

a plurality of cylinders comprising lower ends, each lower end having a slot, wherein the cylinders are located within the perforations of the ring and the protrusions enter the slots of the cylinders.

[c14] The rotary steerable drilling casing system according to claim 7, wherein the sealing system comprises:

a bellows seal located between the tool collar and the drill bit shaft; and

a ring located between the tool collar and the drill bit shaft at the lower end of the tool collar, the ring having an upper end and a lower end.

[c15] The rotary steerable drilling system according to claim 7, wherein the motor is an annular motor.

[c16] The rotary steer able drilling system according to claim 15, further comprising a tube adapted to conduct drilling fluid from an upper end of the motor to the upper end of the drill bit shaft.

[c17] The rotary steerable drilling casing system according to claim 7 wherein the variable bit shift angulating mechanism is one of a fixed offset, mechanically fixed, selectively fixed, fixed at the surface and combinations thereof.

[c18] A rotary steerable casing drilling system, comprising:  
a casing string for rotation of a drill bit;  
a control unit disposed in a drill collar, the control unit comprising  
an instrument carrier;  
a first impeller coupled to the instrument carrier; and  
a second impeller coupled to the instrument carrier,  
a pad section having at least one pad hydraulically extensible therefrom; and

a valve system operatively coupled to the control unit and adapted to selectively conduct at least a portion of a drilling fluid to the at least one pad whereby the at least one pad moves between an extended position and a retracted position, wherein the control unit remains in a geo-stationary position and operates the valve system to modulate a fluid pressure supplied to the pad section in synchronism with rotation of the casing string so that the at least one pad is extended at the same rotational position so as to bias the drill bit in a selected direction.

- [c19] The rotary steerable casing drilling system according to claim 18, wherein at least one of the first impeller and the second impeller is coupled to the instrument carrier by a variable-drive coupling.
- [c20] The rotary steerable casing drilling system according to claim 13, wherein the variable-drive coupling comprises an armature disposed in the instrument carrier and magnets disposed in a sleeve of the at least the first impeller and the second impeller.
- [c21] The rotary steerable casing drilling system according to claim 18, wherein the control unit is coupled to the drill collar by a first bearing and a second bearing.

[c22] The rotary steerable casing drilling system according to claim 18, wherein the at least one pad comprises three pads that are equally spaced around a periphery of the pad section.

[c23] The rotary steerable casing drilling system of claim 17 further comprising a downhole power source selected from the group of motors, turbines and combinations thereof.